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DREDGED MATERIAL RESEARCH

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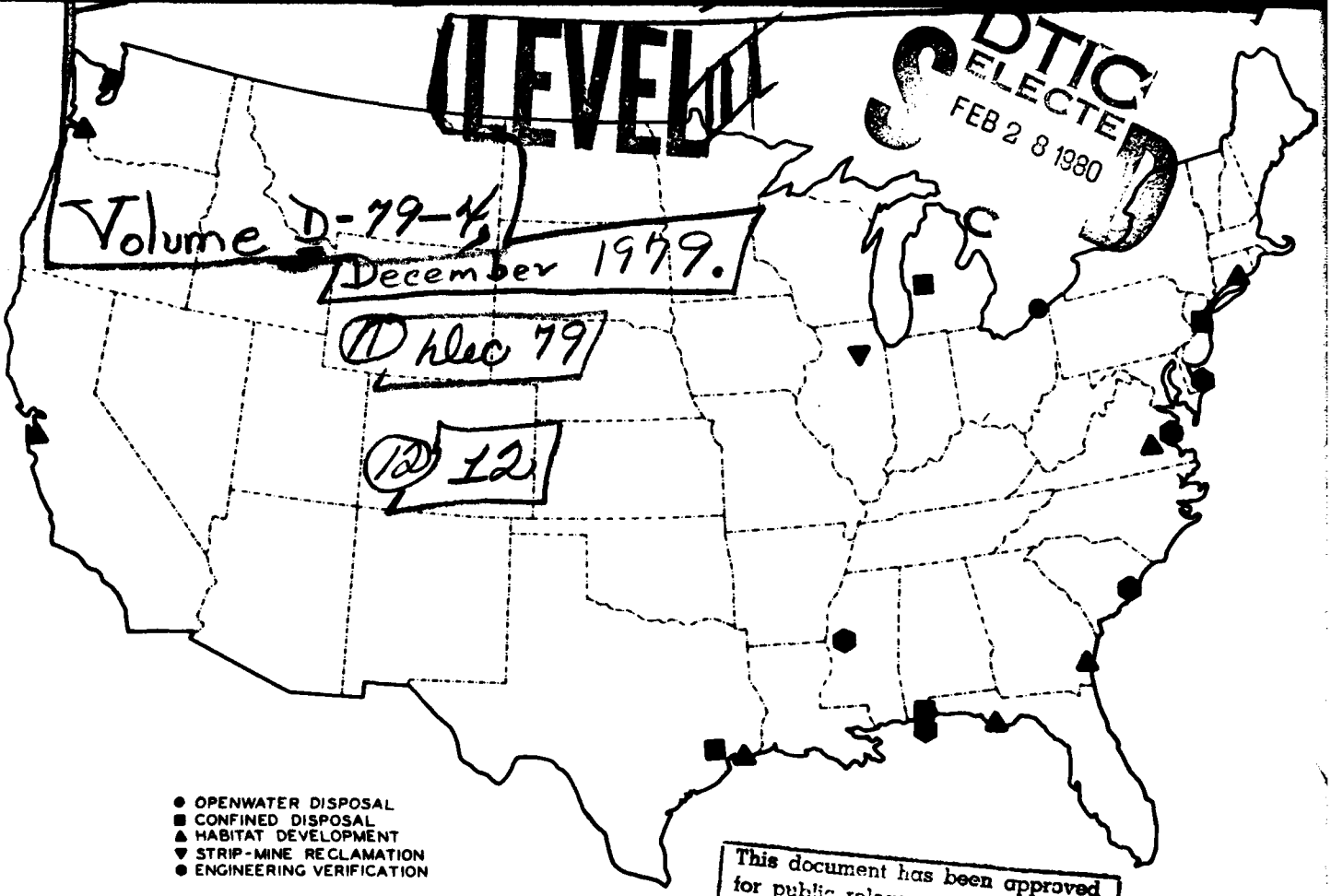
NOTES • NEWS • REVIEWS etc



The Dredging Operations Technical Support (DOTS) Program was established to ensure the transfer of the technology developed by the Dredged Material Research Program (DMRP), to continue monitoring selected DMRP field sites, and to verify and refine engineering and operational procedures developed during the program. The locations of the field sites are shown above. Research is also being conducted to support the Corps' environmental regulatory program. The current status of the DOTS Program is given in the following article.

DOTS STATUS REPORT

It became apparent during the conduct of the Dredged Material Research Program (DMRP) that it would be necessary to continue the technology transfer activities after a program of such magnitude was completed for the results to have maximum benefits. Also, the need was apparent to continue monitoring selected DMRP field sites to better establish long-term trends and to verify and refine engineering and operational procedures developed during the program. In addition, there is a continuing requirement to conduct research to support the Corps' dynamically evolving environmental regulatory program. To meet these needs, the DOTS Program was established by OCE in April 1978, and responsibility was assigned to the Waterways Experiment Station's Environmental Laboratory (EL). The program is managed by Mr. Charles C. Calhoun, Jr., who is assisted by Mr. Thomas R. Patin and Dr. Thomas D. Wright.

The following status report on the program is a general overview to make the reader aware of the assistance offered, the scope of the field studies, and the direction of ongoing research in the regulatory field.

ASSISTANCE TO OPERATING ELEMENTS

As has been noted in previous editions of this bulletin, advisory teams with DMRP technical and management expertise have been in existence since April 1978 to provide Corps operating elements and OCE with rapid-response assistance in solving site-specific problems associated with the environmental effects of dredging and dredged material disposal. DOTS management assembles these teams from within and outside of EL to address the specific requests for assistance.

In FY 79, 94 major requests for assistance from 28 Corps elements were acted upon. The diversity of the problems has required the expertise from essentially all professional disciplines at WES, as well as from selected consultants. In most cases, several man-days of effort were expended, site visits were made, and/or participation in hearings was required. In addition to the major requests, less extensive assistance was often provided by telephone or correspondence.

Assistance has been provided for such functions as briefings and conducting workshops for Districts and other groups, developing study plans and project monitoring strategies, preparing guidelines and criteria for regulatory programs, analyzing disposal alternatives (including habitat development and productive uses), designing effluent treatment facilities, and providing expert testimony in hearings and other litigation. Specifics of the assistance provided in all cases would be too voluminous to cite here; however, some examples are given in the following paragraphs.

The requirements for the Corps to obtain state water-quality certification pursuant to the Federal Water Pollution Control Act (FWPCA) Amendments of 1972 and 1977 (Public Law (PL) 92-500) on dredging projects has had a significant impact on the DOTS Program. Several Districts have requested DOTS to conduct briefings and workshops for state regulatory agencies to assist in the development of implementable and technically sound criteria and guidelines. Also, DOTS team members have assisted in preparation for state hearings on regulatory matters pursuant to the FWPCA and have also presented expert testimony at hearings. Expert testimony has also been given in litigation concerning the Corps' implementation of the Ocean Dumping Program.

Regulations to implement Section 103 of PL 92-532 (Marine Protection, Research, and Sanctuaries Act of 1972) require that Environmental Impact Statements (EISs) be prepared for interim dredged material ocean disposal sites. In conjunction with EPA, data necessary for the EISs are being gathered on a nationwide basis under contract. Responsibility for technical management of the contract was assigned to DOTS by OCE. Dr. Wright is the technical manager.

At the request of OCE, an environmental management proposal was prepared for the Department of State and submitted to the Saudi-Sudanese Commission for Development of Red Sea Resources. The proposal is for environmental studies associated with deep-sea mining of metalliferous muds and for assessing the impact of other cultural activities on Red Sea ecosystems. Action on the proposal, now assigned to the Mideast Division, is expected later this year. Dr. Wright is DOTS liaison on the project.

In summary the technical advisory function of DOTS has been used extensively by Corps elements at all levels, indicating widespread application of the results of the DMRP and other environmental research.

LONG-TERM MONITORING

Open-Water Disposal Sites

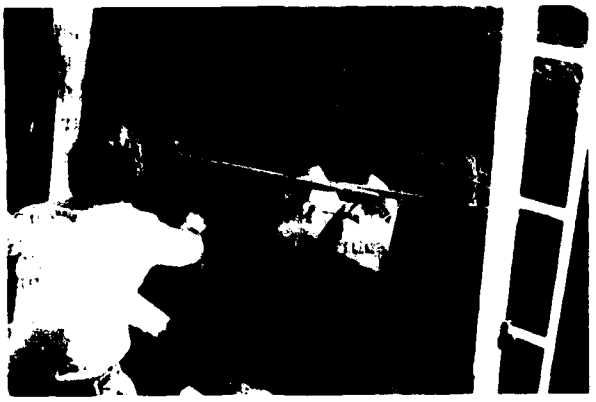
Four major field studies of the effects of dredged material disposal at open-water sites were completed under the DMRP in cooperation with Corps Districts.

These field studies incorporated extensive investigations prior to, during, and after disposal operations; however, there was not sufficient time within the DMRP to completely assess longer term (greater than 2 years) effects and trends after disposal and during critical ecological cycles. The continuation of site-monitoring activities provides an opportunity to assess selected sites at a low-level of effort for an additional 3-year period and will result in an assessment of longer term effects. Specific goals are to determine changes in the communities of bottom-dwelling organisms, to ascertain the nature of longer term changes in sediment chemistry and hence the pollution potential of the material, and to determine the physical stability of the disposed materials.

The two open-water disposal sites selected for further study are in Lake Erie near Ashtabula, Ohio, and in the Duwamish Waterway near Seattle, Washington (Figure 1.) The sites represent conditions in a freshwater and a marine environment. The contractors conducting the site activities at Ashtabula and Duwamish are Roy F. Weston, Inc., and URS Company, respectively. The monitoring efforts are under the general direction of the WES principal investigator Dr. Henry E. Tatem of the Ecosystem Research and Simulation Division (ERSD) of EL.

Confined Disposal Sites

Long-term studies are being conducted to characterize the leachate from four confined disposal sites to determine the degree of mobilization and movement of contaminants from the sites. The sites



a. Van Veen benthic sampler being lowered into bay

b. Sediment and animals from one Van Veen grab

c. Muddy debris and animals remaining after processing

d. Identification of animals

Figure 1. Sediment and animals sampled from bottom of Elliott Bay near Seattle, Washington, October 1979, to check the long-term effects of open-water disposal of dredged material

are located at or near Grand Haven, Michigan; Sayreville, New Jersey; Pinto Island, Alabama; and Houston, Texas. The University of Southern California is conducting the investigation under contract with WES. The WES principal investigator is Mr. Ronald E. Hoeppel of the ERSD.

Habitat Development Sites

Seven marsh and upland habitat development field sites established during the DMRP were chosen for continued monitoring. Figure 2 shows the marsh development site on Drake Wilson Island, an island resulting from dredged material disposal in Apalachicola Bay, Florida. Three reference areas have also been selected for each field site and are being monitored. The location and description of the field sites and the objectives of the field study are given in Table 1.

The first two objectives shown in Table 1 are being accomplished through field sampling and data analysis of underground and aboveground root biomass, plant height, and stem density. Soil measurements include, at a minimum, nutrients, cation exchange capacity,

Table 1
HABITAT DEVELOPMENT FIELD STUDY SITES

Site Location	Type	Objectives*
Miller Sands, Columbia River Oregon	Marsh, Upland	a, b, c
Bolivar Peninsula, Galveston Bay, Texas	Marsh, Upland	a, b, c
Buttermilk Sound, AIWW, Georgia	Marsh	a, b, c
Windmill Point, James River, Virginia	Marsh	a, b, c
Salt Pond 3, San Francisco Bay, California	Marsh	a, c
Drake Wilson Island, Apalachicola Bay, Florida	Marsh	c
Nott Island, Connecticut River, Connecticut	Upland	c

* Entries in this column are defined as follows:
- a—Document, analyze, and compare characteristics of the plant communities and physical and chemical characteristics of the soils at marsh sites and reference areas.
- b—Document, analyze, and compare sediment characteristics and selected aquatic biota at each marsh site and reference site.
- c—Document and compare the overall conditions and appearance of the field sites with those of the reference areas.

Figure 2. Marsh development site, Drake Wilson Island, Apalachicola Bay, Florida

and particle size. The third objective is being addressed through aerial photography with subsequent ground-truth surveys and topographic surveys. The aerial photography is interpreted for vegetation species composition and patterns of occurrence. Topographic surveys reveal changes in elevation and configuration of the site.

The site monitoring efforts are being carried out by the Wetland and Terrestrial Habitat Group, Environmental Resources Division, EL. The work is under the direct supervision of Mr. Charles J. Newling.

Strip-Mine Reclamation Site

During the DMRP, the feasibility of using dredged material to reclaim strip mines was studied at Ottawa, Illinois, with the assistance and cooperation of the Chicago District. Monitoring of this site will continue in order to document changes in leachate water quality and potential for heavy metal uptake by plants. This work is being done under contract with the Argonne National Laboratory under the direction of Mr. Patin.

METHODOLOGY VERIFICATION AND REFINEMENT

Research under the DMRP resulted in guidelines for designing, operating, and managing dredged material containment areas to meet effluent suspended solids standards as well as to provide adequate storage volume. Guidelines were also provided for dewatering fine-grained dredged material that was dredged during maintenance operations and was placed in confined disposal areas.

Field studies are under way to verify and refine the methodology for containment area sizing to optimize suspended solids retention, procedures for estimating hydraulic efficiency and weir design,

procedures for suspended solids removal by chemical treatment, and methodologies for dredged material dewatering. The locations of the sites and the parameters being characterized are given in Table 2 and are discussed in the following paragraphs. All of the studies are being conducted under the general supervision of Dr. R. L. Montgomery, Chief, Water Resources Engineering Group, (WREG), Environmental Engineering Division, EL.

Table 2
ENGINEERING VERIFICATION AND REFINEMENT SITES

Site Location	Parameters*
Fort Eustis, Virginia	S, H, D
Mobile, Alabama	S, H
Yazoo City, Mississippi	S, H, C
Charleston, South Carolina	D
Wilmington, Delaware	D

* Entries in this column are defined as follows: S = suspended solids retention; H = hydraulic efficiency; C = chemical treatment; and D = dewatering effectiveness.

Suspended Solids Retention

Laboratory settling column tests, shown in Figure 3, necessary to size a containment area were performed on sediments taken from the Ft. Eustis, Mobile, and Yazoo City field sites to provide data for comparing design values to values measured from the actual field operation. Additional sites will be evaluated to provide a more comprehensive data base. The principal investigator is Dr. Montgomery.

Hydraulic Efficiency

Dye tracer tests were performed at the sites indicated in Table 2 to provide data on hydraulic efficiencies. Velocity and density measurements were made at the weirs to be used for comparing actual weir performance with weir performance estimated from the DMRP design procedures. Dr. Eugene R. Perrier, WREG, is the principal investigator.

Chemical Treatment

The process of gravity sedimentation will remove dredged material solids down to a low level, with the exact levels depending on the settling properties of the sediment and the characteristics of the containment

Figure 3. Laboratory settling column test setup

area. However, in some instances, agencies may specify criteria for the suspended solids content of the effluent discharged from confined disposal areas that cannot be met by gravity sedimentation alone. In such cases, it is necessary to provide additional treatment for further reduction of suspended solids.

Studies during the DMRP (Figure 4) indicated that chemical coagulation of fine-grained dredged material greatly enhanced the efficiency of the sedimentation process. Two methods of chemical coagulation are being evaluated at the field site on the Yazoo River: chemicals are injected into the dredge discharge pipeline or into weir effluent, which is then passed through small secondary basins. Additional sites will be selected and field tested. This work is under the direction of Mr. A. W. Ford of the WREG.

Figure 4. Chemical coagulation tests

Dewatering Effectiveness

Procedures were developed during the DMRP for dewatering and densifying fine-grained dredged material in place in confined disposal areas. The major technical unknowns in the application of such procedures are the exact rates at which fine-grained dredged material dewatering, densification, surface subsidence, and crust formation will occur. Data on these unknowns are being collected at the field sites (Figure 5) indicated in Table 2.

The data will also provide a means of evaluating the volume gained in containment areas by management of surface water to allow maximum drying and crust formation. Data will also be provided on the cost and effectiveness of trenching in containment areas to maximize drainage and drying of dredged material. The principal investigator is Mr. Michael R. Palermo, WREG.

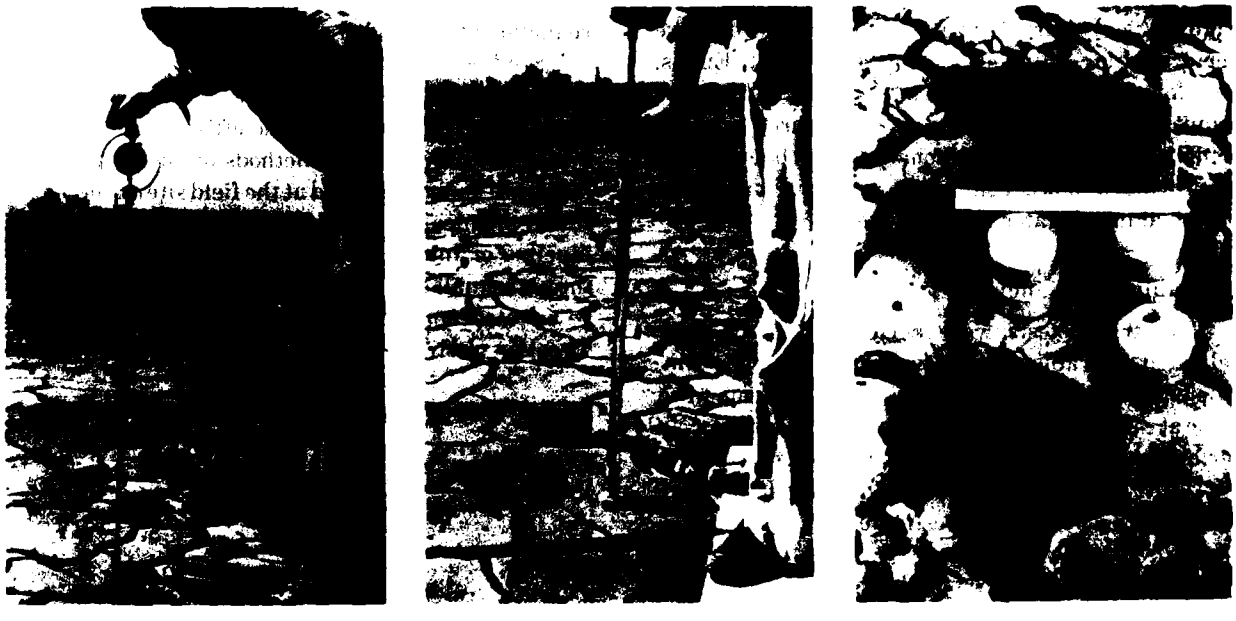
In addition to verification and refinement of dewatering methodologies, the fieldwork is aimed at identifying cost and benefits associated with containment area management activities undertaken for the purpose of dewatering in-place dredged material. Additional field sites will be selected in other geographical locations to provide drying data from areas of the country where different climatic conditions and geologic formations exist.

ENVIRONMENTAL REGULATORY ACTIVITIES

The regulations for the disposal of dredged material continue to evolve and become more refined as additional data become available. Current efforts are directed toward the establishment of an environmentally sound basis for the continuing development of criteria and guidelines for Section 404 of PL 92-500 (FWPCA Amendments of 1977) and Section 103 of PL 92-532 (Marine Protection, Research, and Sanctuaries Act).

Chemical Impacts

There have been a variety of approaches utilized in attempting to predict the chemical impact that the disposal of dredged material will have on aquatic organisms. One of these, bulk sediment analysis, provides an estimation of the total constituents present, but it does not give an adequate estimate of the degree to which they may be released or are biologically available. Elutriate procedures (a water or dilute acid leach) provide an estimation of release but are often inconclusive as to biological availability. Bioassays (Figure 6) provide a direct indication of release, bioavailability, and toxicity. However, bioassays are more time consuming and expensive.



a. Strength measurement b. Sampling crust material c. Determination of crust thickness

Figure 5. Monitoring activities at confined disposal site, Wilmington, Delaware

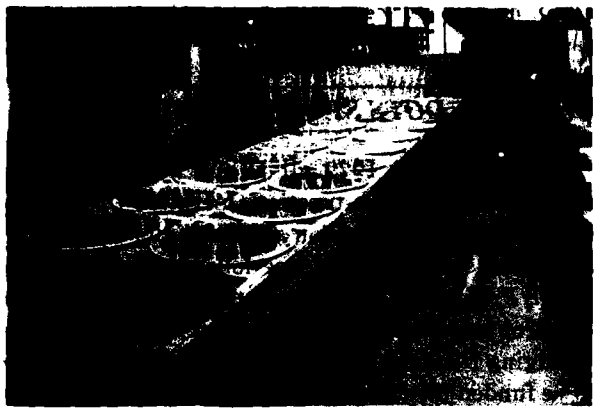


Figure 6. Controlled environment aquarium system being used for development and refinement of bioassay and bioaccumulation procedures

To provide improved reliability of these techniques and to increase cost effectiveness, detailed studies of the relationships between bulk analyses, elutriate tests, and bioassays are being conducted by Dr. Bayliss Proter of Heidelberg College. This approach involves the use of sophisticated statistical procedures to establish relationships between the three techniques in freshwater applications. If successful, the concept will be extended to marine environments.

In conducting bioassays it is essential that appropriate organisms be used to evaluate toxicity. The use of unduly delicate or insensitive species can lead to erroneous or inconclusive data. In addition, organisms that are tolerant of chemical impacts may be quite intolerant of physical impacts (such as turbidity or burial). These factors need to be taken into account in species selection.

To provide information to the field on the selection of appropriate species in various environments and geographic regions, EG&G Bionomics is currently working under contract to develop a species selection guide. The guide will be designed for use with Section 404 of PL 92-500 and Section 103 of PL 92-532. The principal investigator for the chemical impacts studies is Dr. R. K. Peddicord of ERSD.

Ocean Disposal

Section 103 of PL 92-532 requires that an EIS be prepared for designated interim ocean disposal sites. Although initial efforts on a number of major sites are being carried out under contract with Interstate Electronics Corporation, data for the remaining sites and new sites will need to be developed by field agenices.

Even though most ocean disposal sites will have various unique features, a handbook of general guidance for site-survey procedures is being developed under contract by TerEco Corporation. The handbook will cover such topics as experimental design, sampling gear, analytical procedures, and interpretation of results. It has undergone field review and is expected to be available early in 1980. Dr. Peddicord is the principal investigator.

Upland Disposal

Concern has been expressed over the possible uptake of contaminants by plants in upland dredged material disposal areas and the subsequent transfer to animals. To determine the extent and conditions under which such a situation might occur, Dr. C. R. Lee of ERSD is conducting uptake studies. The results of the studies will be used in regulatory decisions involving upland disposal.

Wetlands Criteria

The objective of the wetlands criteria studies is to develop wetlands identification and delineation methodologies that can assist in determining jurisdictional authority as prescribed by Section 404 of PL 92-500. The research efforts have been divided into three task areas: transition zone analysis, wetland guide development, and technology transfer. The work is under the direction of Dr. R. T. Huffman of the Environmental Resources Division, EL.

Transition Zone Analysis. The ultimate purpose of this research effort is to develop methods to assist the field in determining the geographical boundaries of wetlands. This is being accomplished on a regional basis by studying wetland plant community structure in transition zones between wetland and nonwetland areas and relating this to such factors as hydrologic regime, precipitation patterns, edaphic factors, topographic relief, drainage patterns, and associated biota. This work is being conducted jointly with the Corvallis Environmental Research Laboratory of the Environmental Protection Agency utilizing both in-house and extramural research expertise.

Regions of the United States being studied include Peninsular Florida, North Atlantic States, South Atlantic States, West Coast States, Gulf Coastal Plain, Interior, Alaska, Hawaii, and the Island Territories. Ongoing contracts are shown in Table 3. After field testing and review for reliability, methods and guidelines developed for delineation of wetlands will be incorporated into a series of regional wetland working guides.

Table 3

CONTRACTED TRANSITION ZONE VEGETATION STUDIES

Contractor	Study Area
Energy Resources Company, Inc.	Connecticut River Basin
Envirosphere Company	Altamaha River Basin of Georgia
Environmental Science and Engineering, Inc.	Mid-Pennisular Florida
Environmental Science and Engineering, Inc.	Mississippi River Delta of Southern Louisiana
Virginia Polytechnic Institute and State University	Missouri River Basin of South Dakota

Wetland Guide Development. The purpose of this effort is to develop definitive technical information and criteria in a regional guidebook format to assist the field in the identification and delineation of wetlands. Regions of the United States being addressed include Peninsular Florida, Gulf Coastal Plain, West Coast States, Alaska, Interior, North Atlantic States, South Atlantic State, Hawaii, and the Island Territories.

Initial efforts have been directed toward publication of a series of preliminary guidebooks that offer interim technical guidance until a series of working field guides can be developed. These preliminary guides present information that aids in the recognition of various physiognomic types or categories of wetlands and general descriptions of plant communities found within each category. Research is now under way to provide regional working guidebooks for the field that will contain definitive technical information on the plant community structure, hydrologic regimes, edaphic factors, functional values, and cumulative impacts typically associated with wetlands. Techniques for the identification and delineation of wetlands will be emphasized.

Information Transfer. The purpose of this task is to provide the field with up-to-date information on wetlands identification and delineation and to allow for broad input and review of planned or ongoing wetlands criteria research. This information transfer effort is being accomplished through review of draft reports, regional workshops on wetlands identification and delineation, newsletter articles, published reports, and answers to requests for wetlands criteria assistance.

DOTS SPONSORSHIP

Through FY 1979 all DOTS activities were sponsored by the Construction-Operation Division of OCE. With the formation of the Water Resources Support Center (WRSC) (see following article), the DOTS Program with the exception of the regulatory research activities will be funded through the WRSC Dredging Division. Regulatory research will continue to be funded through OCE Con-Ops.

CORPS DREDGING PROGRAM TO BE MANAGED BY NEW CENTER

LTG J. W. Morris, Chief of Engineers, has announced that the Corps' dredging program will be managed by the Dredging Division of the recently established Water Resources Support Center (WRSC). The Center is located adjacent to the Kingman Building at Fort Belvoir, Virginia. COL Maximilian Imhoff was named the Center's first Commander and Director. He will report directly to the Director of Civil Works in the Office, Chief of Engineers. Mr. William R. Murden is Chief of the Dredging Division.

Establishment of the WRSC Dredging Division consolidates all of the Corps' dredging activities including scheduling and control of plant. The Division will provide overall management of the Operations and Maintenance Programs and Revolving Fund Operations, monitor the Construction General Program, and supervise the work of the Marine Design Division. The Division has responsibility for the Ocean Dumping Program for the disposal of dredged material, which requires maintaining close liaison with EPA.

The Center will perform certain other operational functions traditionally assigned to the Civil Works Directorate. These functions include the Dam Inspection Program, preparation of Volume II of the Annual Report, the Stream Bank Erosion Control Program, Water Spectrum Magazine, hydrological data collection, historical data files, resources

(Continued on page 12)

DMRP PUBLICATIONS

Jones, R. H., Williams, R. R., and Moore, T. K., "Development and Application of Design and Operation Procedures for Coagulation of Dredged Material Slurry and Containment Area Effluent," Technical Report D-78-54, September 1978, prepared by Jones, Edmunds and Associates, Inc., and the Environmental Laboratory. (Work Unit 6B08.)

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Cole, J., and Brainard, M., "Evaluation of Laws and Regulations Impacting the Land Use of Dredged Material Containment Areas," Technical Report D-78-55, September 1978, prepared by Science Applications, Inc., Environmental Sciences Division, for the Environmental Laboratory. (Work Unit 5D04.)

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Holliday, B. W., Johnson, B. H., and Thomas, W. A., "Predicting and Monitoring Dredged Material Movement," Technical Report DS-78-3, December 1978, Environmental Laboratory and Hydraulics Laboratory. (Work Unit 1B12.)

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Burks, S. A., and Engler, R. M., "Water Quality Impacts of Aquatic Dredged Material Disposal (Laboratory Investigations)," Technical Report DS-78-4, August 1978, Environmental Laboratory. (Work Unit 1C07.)

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Chen, K. Y., et al., "Confined Disposal Area Effluent and Leachate Control (Laboratory and Field Investigations)," Technical Report DS-78-7, October 1978, prepared by the University of Southern California, Los Angeles, for the Environmental Laboratory. (Work Unit 2D06.)

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Haliburton, T. A., "Guidelines for Dewatering/ Densifying Confined Dredged Material," Technical Report DS-78-11, September 1978, Environmental Laboratory. (Work Unit 5A21.)

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Barnard, W. D., "Prediction and Control of Dredged Material Dispersion Around Dredging and Open-Water Pipeline Disposal Operations," Technical Report DS-78-13, August 1978, Environmental Laboratory. (Task 6C.)

Smith, H. K., "An Introduction to Habitat Development on Dredged Material," Technical Report DS-78-19, December 1978, Environmental Laboratory. (Work Unit 2A09.)

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Spaine, P. A., Llopis, J. L., and Perrier, E. R., "Guidance for Land Improvement Using Dredged Material," Technical Report DS-78-21, December 1978, Environmental Laboratory. (Task 3B/4C.)

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Environmental Laboratory, Beeman, O., and Benkendorf, A. P., "Land Use of Dredged Material Containment Areas: Productive Use Examples," Miscellaneous Paper D-78-4, August 1978, Beeman/Benkendorf and Environmental Laboratory. (Work Unit 5D03.)

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Landin, Mary C., "A Selected Bibliography of the Life Requirements of Colonial Nesting Waterbirds and Their Relationship to Dredged Material Islands," Miscellaneous Paper D-78-5, September 1978, Environmental Laboratory. (Work Unit 4F04.)

FINAL REPORTS

A single-volume summary of the DMRP, Technical Report DS-78-22 entitled "Executive Overview and Detailed Summary," is available on request. The companion report, Technical Report DS-78-23 "Publication Index and Retrieval System," is being prepared under contract by Herner and Company of Washington, D. C. and will be released for distribution early in 1980.

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NOTE: Copies of the above reports will be furnished to individual requestors as long as supplies last. Since it is only feasible to print a limited number of copies, requests for single rather than multiple copies by a single office will be appreciated. Please address all requests to the Waterways Experiment Station, ATTN: Ms. D. P. Booth. When supplies are exhausted, copies will be obtainable from the National Technical Information Service, 5205 Port Royal Road, Springfield, VA 22151.

NEW LITERATURE

Quick, J. A., Jr., and Morris, J. A., "Experimental Extensive Culture of Penaeid Shrimp in a Simulated Dredged Material Disposal Area," *Proceedings of the Seventh Annual Meeting, World Mariculture Society, San Diego, California*, January 1976, pp 305-325.

Large amounts of soil and sediment are removed during dredging operations that dig channels, deepen harbors, and accomplish other activities necessary to maintain our navigable waters. Much of this dredged material must be disposed of in diked land disposal sites. The soft consistency of most of these sediments makes these containment areas unavailable for usual productive uses, such as agriculture, for periods of months or years.

Shrimp mariculture in seawater overlying the sediment in disposal sites was proposed as a possible use of these areas. A preliminary evaluation was made by simulating a containment area.

The bottoms of two 0.1 hectare (¼ acre) shrimp culture ponds were covered with a thick layer of freshly dredged channel sediment. Two adjacent ponds served as controls. All four ponds were fertilized and stocked with hatchery reared postlarval brown shrimp (*Penaeus aztecus*). No supplemental food was provided. At harvest 3 months later, average survival was 75%. Shrimp in the ponds containing dredged materials grew 30% faster than controls averaging 3.95 grams each (185 count per pound). The harvest rate averaged 100 kilograms (220 pounds) per acre and was 19% higher in the experimental ponds.

Churchill, L. A. C., et al., "Stabilization of Subtidal Sediments by the Transplantation of the Seagrass *Zostera marina*," December 1978, New York Sea Grant Institute, State University of New York, Albany.

The seagrass *Zostera marina* has been successfully transplanted onto dredge spoil, and according to the work of Churchill, Cok, and Riner, this method seems a good way to stabilize unconsolidated sediments. The researchers recommend manually transplanting miniplugs of seagrass-sediment-free clusters of four to six shoots—together with entangled roots and rhizomes. A total of 5.061 miniplugs were planted in an area of 0.06 hectare (0.14 acre) with 80% survival. Researchers noted a two- and three-fold increase in rhizome length and shoot number, respectively, during the first four months. Planting 0.41 hectare of seagrass (1 acre), they estimate would cost $3,370.

Schlapak, B. R., and Herbich, J. B., "Characteristics of Coral and Coral Dredging," Report No. TAMU-SG-78-207, June 1978, Sea Grant College Program, Texas A&M University, College Station, Texas.

This report was prepared to fill the information gap for civil engineers involved with the dredging of coral and its use as construction material. Eighteen kinds of coral are discussed and illustrated in terms of engineering properties, excavation data, coral reef formation and world-wide distribution.

Siipola, M. D., et al., "A Model for Early Stability of Subaerial Dredged Material Piles," *Bulletin of the Association of Engineering Geologists*, Vol 14, No. 4, 1977, pp 225-243.

Subaerially dredged material piles in rivers and coastal zones depend ultimately on the establishment of vegetation cover for stability. Even under optimum conditions, however, freshly deposited sandy "spoil" is exposed to the erosive effects of wind and rainfall for significant periods of time. Very little information is available on these early processes and their effects.

A model for the early response of dredged material piles to wind deflation and raindrop effects is proposed based upon available theoretical and experimental literature. The fit of the model to field measurements is illustrated using data from three sites in coastal North Carolina. Results indicate that simple field measurements can provide a reasonable estimate of future exposure effects on existing or potential dredged material piles.

Cammen, L. M., "Abundance and Production of Macroinvertebrates from Natural and Artificially Established Salt Marshes in North Carolina," *American Midland Naturalist*, Vol. 96, No. 2, October 1976, pp 487-493.

From March to November 1973, core samples were taken from dredge spoil planted with *Spartina alterniflora*, spoil left bare and nearby natural marsh at Drum Inlet and Snow's Cut, North Carolina. Insect larvae were dominant in the fauna of both spoil areas at Drum Inlet while polychaetes dominated the natural marsh fauna. At Snow's Cut, polychaetes were dominant in the fauna of the bare spoil, while the planted spoil fauna consisted mainly of amphipods and insect larvae; polychaetes, isopods and mussels were the most abundant natural marsh fauna. The creek fauna of both Drum Inlet and Snow's Cut was dominated by polychaetes. Annual macrofaunal production was estimated for both Drum Inlet and Snow's Cut. Production estimates for creek stations generally were higher. There was no consistent relation between the presence of *Spartina* and the abundance of macrofauna in the spoil plots.

Krizek, R. J., et al., "Water Quality Effects of a Dredging Disposal Area," *Journal of the Environmental Engineering Division, ASCE*, Vol.102, No. EE2, Proceedings Paper 12040, April 1976, pp 389-409.

The effect of the settling-basin concept on the water quality associated with a typical disposal site for

polluted maintenance dredgings, and the fate of pollutants during a typical dredging and disposal cycle were determined between August 20, 1972 and December 20, 1972, in Toledo, Ohio. Over 100 samples of slurry influent, overflow effluent, groundwater, ambient river water, bottom sediments, and material from the hopper bins and overflow waters were collected and analyzed for standard physical, chemical, and microbiological parameters. It was concluded that only a small fraction of the pollutants are discharged via the overflow weir into the ambient river water; this is attributable to the fact that the polluting substances tend to associate with the solid particles, which settle out of the suspension and are retained within the diked enclosure. The water quality of the effluent resembled that of the ambient river water used as a carrier to pump the dredgings in slurry form from the hopper dredge into the disposal area.

Morton, J. W., "Ecological Effects of Dredging and Dredge Spoil Disposal: A Literature Review," Technical Paper No. 94, 1977, U. S. Fish and Wildlife Service, Washington, D. C.

The goal of this study was to prepare a comprehensive review of the literature on the physical, chemical, and biological effects of dredging and spoil disposal in estuaries and to identify alternative spoil disposal methods. Specific objectives were to identify the most critical problems relating to dredging and spoil disposal and to summarize the progress made to date in solving these problems. Using literature search facilities, bibliographies, and communications with experts throughout the united States, I screened about 520 scientific and technical articles on dredging and spoil disposal. Information extracted from selected articles is included in this review.

An important physical effect of dredging and open-water spoil disposal is alteration of circulation patterns that results when dredged channels and spoil mounds block and reroute tidal currents, induce shoaling, or alter flushing rates. A second important effect is the uncontrolled redistribution of sediments eroded from the spoil mound at the disposal site. Processes influencing erosion and sediment-transport mechanisms are too poorly understood to permit the construction of models for the prediction of long-term fate of dredge spoils after they are deposited at the disposal site.

Changes in the chemistry of the sediments at the dredging and disposal sites and of the water overlying these areas are likely to result from dredging and dumping, especially if the dredged sediments have a high organic content or are contaminated. One of the most critical, yet least understood, problems is the possible remobilization of contaminants as polluted sediments are dredged and deposited at the disposal site. Several interacting factors and processes are believed to control the flux of contaminants across the sediment-water interface: the sediment's clay fraction and organic content, redox (oxidation-reduction) potential, pH, bacteria, the sulfur cycle, and the iron cycle. A conceptual model of how these variables interact is presented.

Although direct burial of organisms and destruction of the habitat (altering its physical and chemical characteristics) are the two most obvious biological effects of dredging and dumping, the effects can be reduced by careful timing of the dredging and placement of the spoil. A critical problem requiring further study is the uptake and concentration of contaminants associated with polluted dredge spoils by marsh vegetation, phytoplankton, zooplankton, benthos, and fish.

To minimize the various physical, chemical, and biological effects of dredging and dumping, engineers and biologists are attempting to improve existing dredging techniques and find suitable alternatives to unconfined, open-water spoil disposal. Possible alternatives include the use of diked or confined disposal areas, construction of marshes and spoil islands, and treatment and inland transport of dredge spoils for landfills. Although construction of marshes and spoil islands is not yet operationally practical, this is one of the more promising alternative spoil disposal methods.

IN MEMORIAM

Thomas K. Moore, Environmental Engineering Division, Environmental Laboratory, died on 29 September 1979 as a result of the crash of his private airplane. During the DMRP, Tom was manager of Task 6B, Treatment of Contaminated Dredged Material. At the time of his death he was responsible for the DOTS laboratory and field studies to verify and refine dredged material treatment techniques. As a recognized expert in the field, he had assisted various Corps Districts in designing and implementing treatment schemes under the DOTS Program. Tom will be greatly missed by his many friends within and outside the Corps. Sympathy is extended to his wife and young daughter.

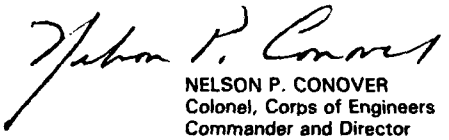
CORPS DREDGING PROGRAM (Cont.)

allocation, and selected project management.

The Center will also conduct and manage water resource studies and provide technical support to the other offices in matters dealing with water resource management.

Some other elements of the Corps already located in the Kingman Building will be incorporated into the new Center, including the Port Facility Division of the Board of Engineers for Rivers and Harbors and the Institute for Water Resources. In addition, the Center will manage the work of the Waterborne Commerce Statistic Center in New Orleans although the activity will remain at its present location.

This bulletin is published in accordance with AR 310-2. It has been prepared and distributed as one of the information dissemination functions of the Environmental Laboratory of the Waterways Experiment Station. It was published during the conduct of the Corps of Engineers' nationwide Dredged Material Research Program (DMRP) to disseminate program results rapidly and widely to Corps District and Division offices, as well as other Federal agencies, state agencies, universities, research institutes, and individuals. The DMRP was completed in March 1978, but the bulletin will be published under the Corps' Dredging Operations Technical Support (DOTS) program as part of the program mission to continue information dissemination and to assist in implementation of DMRP results. The bulletin will be issued on an irregular basis as dictated by the quantity and importance of information available for publication. Contributions of news, notes, reviews, or any other type of information are solicited from all sources and will be considered for publication as long as they are relevant to the DOTS theme of providing definitive information on the environmental impact of dredging and dredged material disposal operations and the development of technically satisfactory, environmentally compatible, and economically feasible dredging alternatives, including consideration of dredged material as a manageable resource. Special emphasis is placed on material relating to application of research results or technology to specific project needs. Communications are welcomed and should be addressed to the Environmental Laboratory, ATTN: Mr. C.C. Calhoun, Jr., U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 39180, or call AC 601/634-3428 (FTS 542-3428).



NELSON P. CONOVER
Colonel, Corps of Engineers
Commander and Director